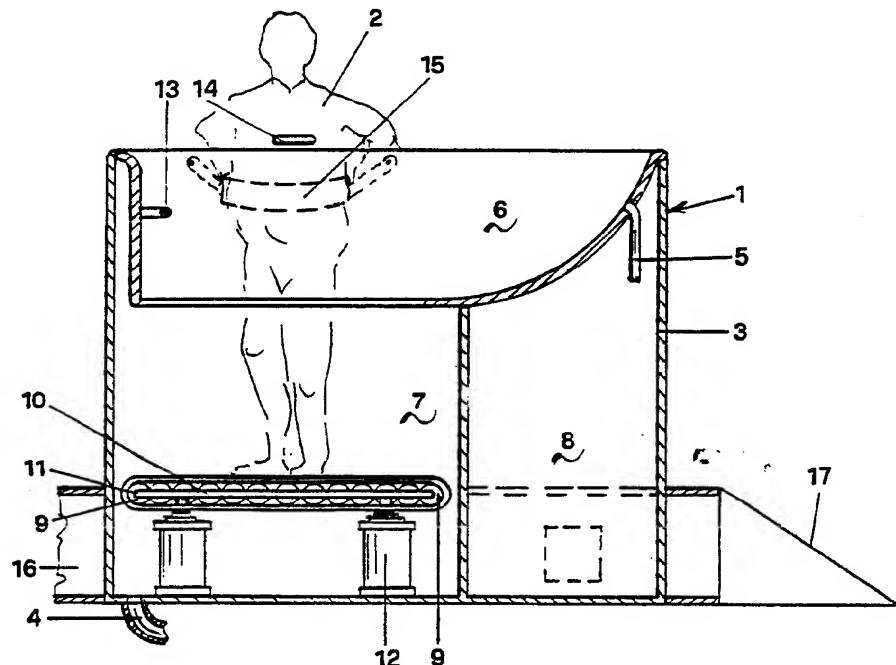




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## (54) Title: HYDROTHERAPY DEVICE WITH UNDERWATER TREADMILL



## (57) Abstract

Adjustable segmental load orthostatic rehabilitation device, characterised in that it comprises a tub (1), large enough to hold a patient (2) in the erect position, and provided with a moving sidewalk (8), located on the bottom of the tub, on which the patient is asked to walk.

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Hydrotherapy device with underwater treadmill

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The present invention relates to an adjustable segmental load orthostatic rehabilitation device.

Hydrotherapy is widely adopted in the field of physical medicine, in that it constitutes one of the fundamental pillars of the treatment and rehabilitation of patients suffering from various rheumatic disorders, whether inflammatory or degenerative, as well as from many physical traumas (e.g. fractures, sprains, or a sequence of these). In fact, it is commonly known that water, be it from mineral springs or of marine or thermal origin, performs an anti-contractural, anti-inflammatory and sedative function, by virtue of its important physicochemical properties: it is an excellent solvent and a good heat accumulator, and its density is such that the influence of gravity can be remarkably reduced and adjusted, which is of great importance to achieve specific therapeutic purposes; for instance, water has advantageous therapeutic applications in the case of patients needing rehabilitation as a result of lower limb injuries (after-effects of surgically or bloodlessly treated fractures, after-effects of artificial hip or knee operations, reconstitution of ligaments or their substitution for artificial ligaments, meniscectomy, paraplegia or hemiplegia, etc.), as well as in the case of patients

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affected simply by malformations and degenerative or inflammatory pathologies of the lower limbs (arthrosis, rheumatic arthritis).

Nowadays, this sort of therapy is carried out in  
5 hospital or out-patients' physiokinesthesiatherapy centres equipped with special tubs in which patients are immersed. In some hospitals there are also special pools where patients needing early or even very early ambulation can undergo the prescribed rehabilitative hydrotherapy.

10 Nonetheless, this equipment presents considerable disadvantages, notably:

- very great costs of installation and maintenance, with the result that only very few hospitals can afford them;
- an enormous bulk, which very often deprives other equally important services of plenty of space;
- 15 - the necessity of employing a numerous staff to treat and look after the patients
- the need to use the same pool for several patients at a time, with the consequent inability to offer each of them a personalised, and therefore more effective treatment;
- 20 - the difficulty in monitoring hygienic conditions and the consequent need to use water sterilizing substances in high proportions, which might cause allergic reactions or

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- intolerances to these substances in many patients;
- high running costs, due to heating, water recycling and attending staff;
  - the need for patients undergoing rehabilitation training to be hospitalised for quite long periods of time.

5

These drawbacks have considerably hindered the spread of hydrotherapy as carried out in pools, and accordingly restricted the opportunity to resort to early and very early ambulation as a treatment of many lower limb pathologies, 10 with all the disastrous consequences that this situation inevitably produces.

15

According to the invention the problem is solved by means of an adjustable segmental load orthostatic rehabilitation device, characterised in that it comprises a tub, large enough to hold a patient in the erect position and provided with a moving sidewalk, located on the bottom of the tub, on which the patient is asked to walk.

20

The present invention is hereinafter further clarified with reference to the enclosed sheet drawing in which:  
fig. 1 shows a side view of the device in operation  
fig. 2 shows the same view of the device at rest.

As shown in the drawing, the device according to the invention includes a tub 1, the dimensions of which must be

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suitable to hold a patient 2 in the erect position. The tub 1 could, for instance, be 160cm high, 180cm long and 80cm wide. It should preferably be made of metallic or plastic material, with a transparent (e.g. glass or plexiglass) side wall 3. It  
5 will be horizontally divided into two parts: an upper part 6, basically constituting a traditional tub, which is designed to hold the patient 2 in the horizontal position, and a lower part 7, which is meant to hold the patient 2 in the erect position once the two parts of the tub have been made  
10 intercommunicating.

Since the space taken up by the patient is smaller when he is standing than when he is lying, a portion of the lower part 7 of the tub will be used as a container 8 for the apparatus needed to operate the device.

15 Beside the tub there will also be a footboard 16, equipped with a chute 17. Under the footboard 16 there are water treatment and recycling reservoirs 18, equipped with pumps (not shown) for the rapid intake and drainage of water, irrespective of waterworks.

20 The tub 1 is provided with a traditional hole 4 for the drainage of water, and is connected to a pipe 5 fitted to the surge tank, for the intake of more water.

The division between the upper part 6 and the lower part

- 5 -

7 of the tub 1 is obtained by means of a moving sidewalk (globally referred to as 8), equipped with a nonskid rubber mat 9 supported by a roller frame 10 which can be moved vertically, from an upper position (see fig. 2) in which it 5 constitutes the bottom of the upper part 6 of the tub, to a lower position (see fig. 1), in which it is located near the bottom of the tub itself.

The rollers 11 supporting the mat 9 can be either idle or motor-driven, depending on the circumstances. In the 10 latter case, the starter (not shown) of at least one roller should preferably be operated by air and equipped with a variable-speed drive.

The frame 10 supporting the rollers 11 is designed in such a way that it can be tilted lengthways and raised by 15 means of ordinary pneumatic pistons 12 or other suitable mechanical devices.

The tub is also provided with a number of devices to support the patient 2 during the treatment, i.e. handles 13, armpit rests 14 and safety belts 15. Safety belts, in 20 particular, should be inflatable, in order to make it possible to modify the patient's weight and, as a consequence, the load applied to his lower limbs, according to the amount of air inflated.

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As far as the hydraulic system is concerned, the tub 1 can be equipped both with a recycling system, to provide hydromassage and water heating and sterilization, and with small openings for the intake of compressed air, ozone and 5 disinfectant or sterilizing substances.

The device also includes various adjusting and checking devices, particularly as regards the speed of the rubber mat 9, if it is motor-driven, and the operational parameters, i.e. the temperature, level and degree of ozonization of the 10 water, the amount of air and/or water to be used for hydromassage, the load on the mat 9, and so forth.

The device operates as follows: first of all, the patient 2 is immersed in the tub 1 after the roller mat 9 has been raised from the tub bottom, so that 15 the upper part 6 of the tub constitutes an ordinary hydrogalvanic rehabilitation tub or whirlpool bath.

To begin hydrotherapy training, one has simply to lower the roller mat 9. At this stage, the patient 2, who can meanwhile be supported by armpit rests 14, handles 13 or a 20 safety belt 15, passes from the horizontal to the erect position without coming out of water: he is therefore subjected to an upward buoyant force, the magnitude of which is equal to his level of immersion in the water.

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Clearly, this buoyant lift can be predetermined and even freely modified, either by gradually inflating or deflating the safety belt 15, or by changing the level of immersion of the body in the water, which is done by modifying the water level or the position of the mat 9. Once the patient 2 has been immersed in the water and the desired magnitude of the buoyant force has been reached, he is asked to walk on the moving sidewalk 8; if this is mounted on idle rollers 11, the sidewalk backward movement will be obtained simply by virtue 10 of the lower limb thrust (active rehabilitation), and the patient will not move with respect to the tub 1 since he will lean on the handles 13 or be supported by other devices; conversely, if the moving sidewalk is mounted on motor-driven rollers, the patient 2 will have to diversify the rhythm of 15 his movements so as to maintain his position unchanged with respect to the tub 1 (passive rehabilitation).

For some of its possible applications, the moving sidewalk 8 can be tilted, so as to simulate the conditions of walking on an inclined plane.

All checks and adjustments can be made either manually 20 (on the grounds of previously drawn-up tables) or automatically (preferably by using a computer), so as to take carefully into account all the parameters involved in the

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hydrotherapy training and modify them, if necessary, in order to meet specific requirements.

In the light of what has been said thus far, it is easy to appreciate the manifold advantages displayed by the device according to the invention, both in terms of possible fields of application and in terms of versatile uses of the invention.

Particularly useful applications for the device can be found in the field of:

- 10    - rheumatology
- vascular surgery, notably phlebology (venous insufficiencies, stasis edemas, varicous and postphlebitic ulcers, etc.)
- aesthetic medicine and surgery (adjuvant treatment of cellulitis, after-effects of liposuction operations, etc.)
- dermatology (various cutaneous diseases which benefit from ozone treatment and hydromassage)
- geriatrics and internal medicine as a whole, as regards the rehabilitation of patients who have been confined to bed for long periods of time or who suffer from after-effects of hemiparesis or neurological injuries in general, etc.
- 20    - the rehabilitation of the physically disabled.

Yet, the most important application of the device

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according to the invention is in the field of orthopaedics and traumatology, with specific regard to the treatment of patients:

- 5        - suffering from after-effects of both bloodlessly and surgically treated traumatisms (fractures, dislocations, sprains, etc.);
- having artificial joints (hip, knee, ankle) or ligaments (knee, ankle) on;
- treated with osteotomy owing to hip or knee arthrosis;
- 10      - suffering from various malformations (congenital dysplasia, clubfoot, flatfoot or hollow foot), as well as from degenerative pathologies which require long loadlessness periods (e.g. adolescent's hip osteochondritis) and, as a consequence, very long rehabilitation periods.

15        Besides the above-mentioned utilizations of the device, many others are most likely to be discovered in the course of the device practical testing.

- 10 -

C L A I M S

1. Adjustable segmental load orthostatic rehabilitation device, characterised in that it comprises a tub (1), large enough to hold a patient (2) in the erect position, and provided with a moving sidewalk (8), located on the bottom of the tub, on which the patient is asked to walk.  
5
2. Device according to claim 1 characterised in that at least one wall (3) of the tub is made of transparent material.
- 10 3. Device according to claim 1 characterised in that the tub (1) is provided with a water-recycling system.
4. Device according to claim 3 characterised in that the hydraulic system includes a heating element.
- 15 5. Device according to claim 1 characterised in that the tub walls are provided with water and/or compressed air intake openings.
6. Device according to claim 1 characterised in that the tub walls are provided with ozone distribution valves.
7. Device according to claim 1 characterised in that the  
20 tub walls are provided with at least one handle (13) on which the patient (2) walking on the moving sidewalk (8) may lean.
8. Device according to claim 1 characterised in that the tub side walls are provided with armpit rests (14) to support

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the patient (2) walking on the moving sidewalk (8).

9. Device according to claim 1 characterised in that it includes at least one inflatable safety belt (15) to support the patient (2) walking on the moving sidewalk (8).

5 10. Device according to claim 1 characterised in that the moving sidewalk (8) is made up of a mat (9) supported by rollers (11) mounted on a rigid frame (10).

11. Device according to claim 10 characterised in that the rollers (11) are idle with respect to the rigid frame (10).

10 12. Device according to claim 10 characterised in that at least one of the rollers (11) is motor-driven.

13. Device according to claim 12 characterised in that the motor speed and/or acceleration and/or direction of movement are adjustable.

15 14. Device according to claim 10 characterised in that the rigid frame (10) is tilted lengthways with respect to the bottom of the tub (1).

15. Device according to claim 10 characterised in that the rigid frame (10) can be raised with respect to the bottom of the tub (1).

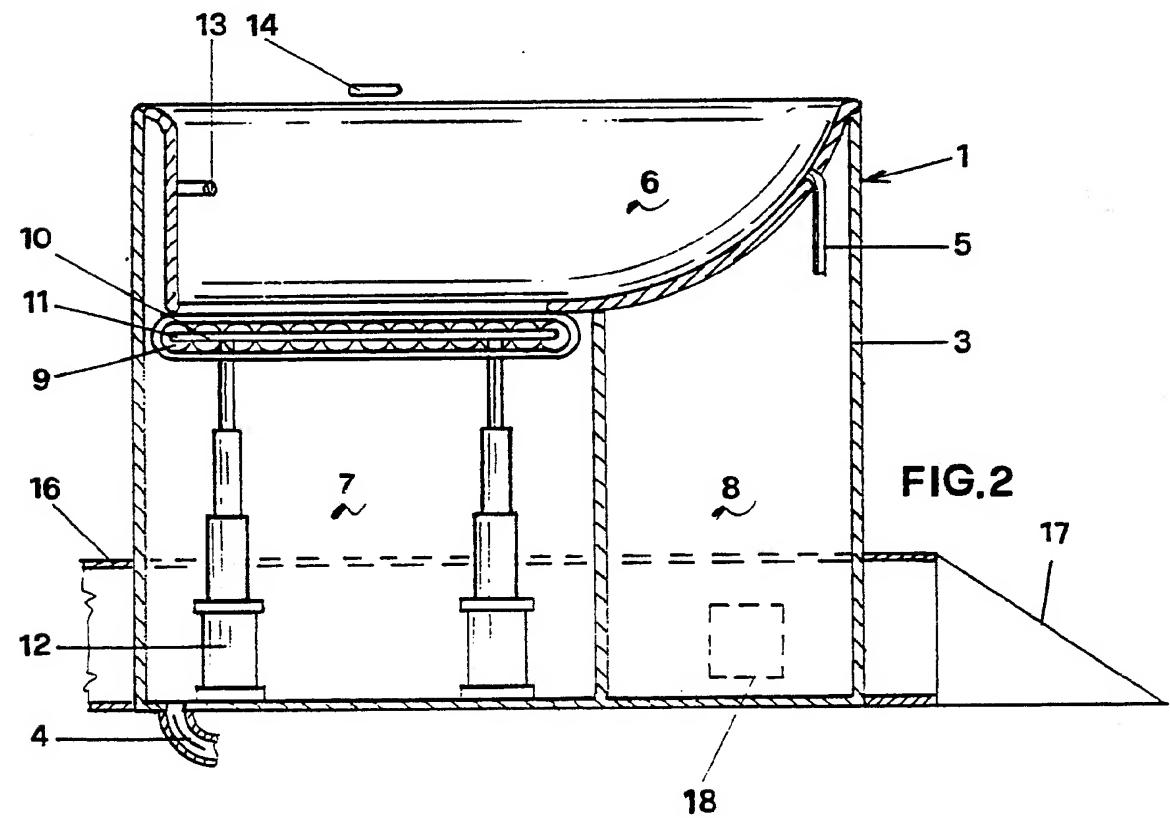
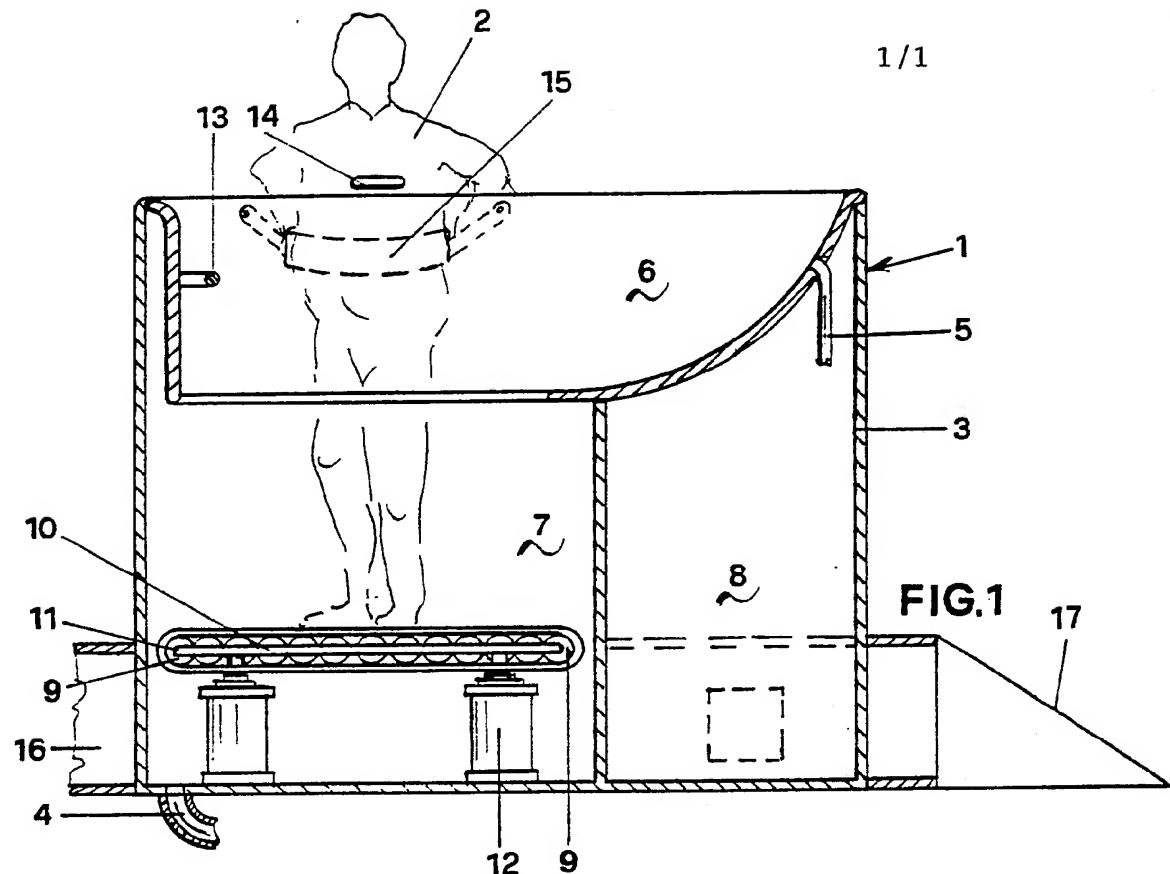
20 16. Device according to claim 2 characterised in that the tub is equipped with internal lighting.

17. Device according to claim 15 characterised in that the

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rigid frame (10) is moved from a lower position, in which the moving sidewalk (8) virtually rests on the bottom of the tub (1), to an upper position, in which the moving sidewalk (8) constitutes the bottom of a traditional whirlpool bath.

- 5        18. Device according to one or more claims from 1 to 17 characterised in that it includes a number of devices for the check and adjustment of the various operational parameters.
19. Device according to claim 1 characterised in that it comprises a footboard (16), located beside the tub.
- 10      20. Device according to claim 19 characterised in that the footboard (16) is equipped with a chute (17), constituting a comfortable means of access to the footboard itself.
21. Device according to claims 19 and 20 characterised in that one or more water-supply and recycling reservoirs (18) are located under the footboard and the chute.
- 15      22. Device according to claims 19, 20 and 21 characterised in that, between the tub and the reservoir(s), there is a system of pumps for the rapid intake and drainage of water.



# INTERNATIONAL SEARCH REPORT

International Application No PCT/EP 90/01134

## I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all)<sup>6</sup>

According to International Patent Classification (IPC) or to both National Classification and IPC  
**IPC5: A 63 B 22/02**

## II. FIELDS SEARCHED

Minimum Documentation Searched<sup>7</sup>

Classification System	Classification Symbols
IPC5	A 63 B; A 61 H

Documentation Searched other than Minimum Documentation  
 to the Extent that such Documents are Included in Fields Searched<sup>8</sup>

## III. DOCUMENTS CONSIDERED TO BE RELEVANT<sup>9</sup>

Category *	Citation of Document, <sup>11</sup> with indication, where appropriate, of the relevant passages <sup>12</sup>	Relevant to Claim No. <sup>13</sup>
X	GB, A, 2200548 (MOUNT PLEASANT WATER THERAPY COMPANY) 10 August 1988, see the claims and figures	1,3-7, 10,12, 13,15 8
Y	--	
X	WO, A1, 8806049 (EDMONDS MEDICAL SYSTEMS, INC.) 25 August 1988, see the claims and the figures	1-7,10, 12,13, 18 8
Y	--	
Y	EP, A1, 0002188 (SCHÖNENBERGER, ROLF DR. ET AL) 13 June 1979, see especially claims 1-7 and 20-22	8
	--	

### \* Special categories of cited documents:<sup>10</sup>

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## IV. CERTIFICATION

Date of the Actual Completion of the International Search

23rd October 1990

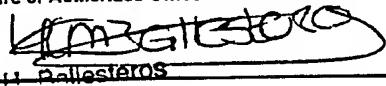
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III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)		
Category *	Citation of Document, with indication, where appropriate, of the relevant passages	Relevant to Claim No
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A	US, A, 4332217 (DAVIS, G.M) 1 June 1982, see the whole document  --	1-22
A	US, A, 4574739 (FONTAINE ET AL) 11 March 1986, see the whole document  --	1-22
A	US, A, 4712788 (GAUDREUAN, JR.) 15 December 1987, see the whole document  -----	1-22

ANNEX TO THE INTERNATIONAL SEARCH REPORT  
ON INTERNATIONAL PATENT APPLICATION NO.PCT/EP 90/01134

SA 38859

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Patent document cited in search report	Publication date		Patent family member(s)	Publication date
GB-A- 2200548	10/08/88		FR-A- 2607389	03/06/88
WO-A1- 8806049	25/08/88		AU-D- 1362388 EP-A- 0345289	14/09/88 13/12/89
EP-A1- 0002188	13/06/79		NONE	
EP-A2- 0103263	21/03/84		AU-B- 536611 AU-D- 1443883 CA-A- 1201342 GB-A-B- 2127267 JP-A- 59135052	17/05/84 22/03/84 04/03/86 11/04/84 03/08/84
US-A- 4576376	18/03/86		NONE	
US-A- 4332217	01/06/82		NONE	
US-A- 4574739	11/03/86		NONE	
US-A- 4712788	15/12/87		NONE	

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82